

Lightweight Superconducting Magnets for Low Temperature Magnetic Coolers, Phase I

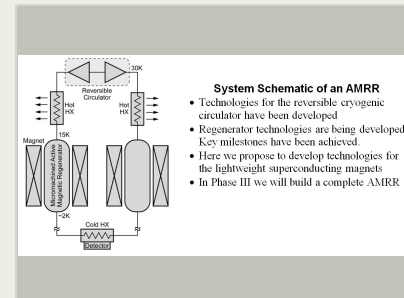
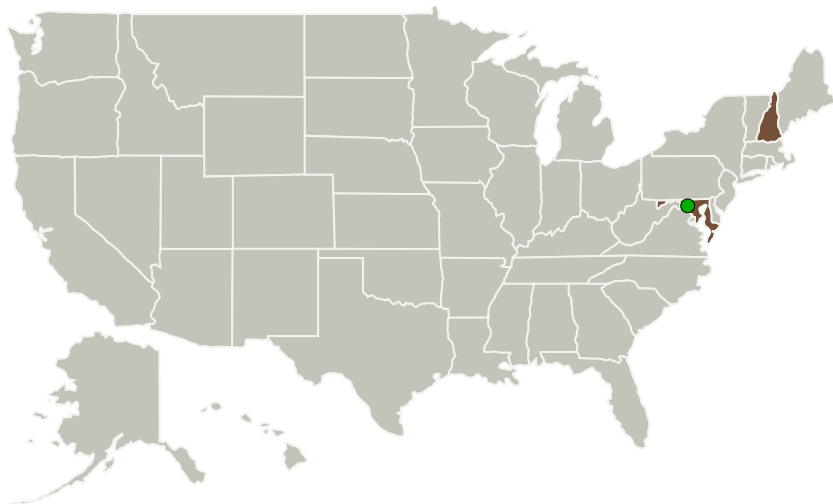
Completed Technology Project (2013 - 2013)



Project Introduction

NASA's future science missions to investigate the structure and evolution of the universe require efficient, very low temperature coolers for low noise detector systems. We propose to develop a highly efficient, lightweight Active Magnetic Regenerative Refrigeration (AMRR) system that can continuously provide remote/distributed cooling at temperatures of about 2 K with a heat sink at about 15 K. The AMRR system uses three novel design features to achieve a large cooling capacity and very high thermal efficiency: a vibration-free, reversible cryogenic circulator; innovative micromachined regenerators; and lightweight superconducting magnets. The superconducting magnet uses low-current superconducting YBCO tapes and a unique winding arrangement to enable an AMRR to achieve high thermal efficiency. In Phase I, we will develop a design for the superconducting magnet and its electrical, thermal, and structural support subsystems. Based on the performance characteristics of the magnet system, we will optimize the magnetic field in the AMRR to minimize the overall system size and mass. In Phase II, we will build a superconducting magnet and demonstrate the performance of a magnetic regenerator driven by this magnet under prototypical conditions. In Phase III, we will assemble an integrated AMRR system and demonstrate its performance.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Creare LLC	Lead Organization	Industry	Hanover, New Hampshire
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Maryland	New Hampshire

Project Transitions

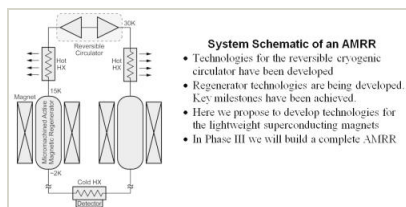
▶ **May 2013:** Project Start

✓ **November 2013:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140437>)

Images



Project Image

Lightweight Superconducting Magnets for Low Temperature Magnetic Coolers

(<https://techport.nasa.gov/image/131959>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Creare LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Weibo Chen

Co-Investigator:

Weibo Chen

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Technology Maturity (TRL)

Start: 2
Current: 3
Estimated End: 3



Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.1 Cryogenic Systems
 - └ TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System